Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office

TOP3–00201

# CARES (Ceramics Analysis and Reliability Evaluation of Structures) Integrated Design Software

## Technology

Design methodologies and attending software that enables significant improvements in assessing the integrity and reliability of advanced structural ceramic and brittle material components.

## Benefits

- Accelerates commercial applications of high-value-added materials
- Enables accurate life prediction of brittle material components by heretofore unavailable computer simulation and design

## Commercial Applications

- Aerospace applications
- Automotive applications
- Propulsion and power applications
- Bioengineering applications
- Glass and other applications

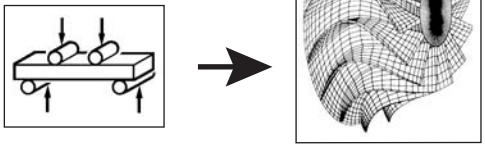
## Technology Description

Researchers in the Life Prediction Branch at the NASA Glenn Research Center have conceived and developed the CARES (Ceramics Analysis and Reliability Evaluation of Structures) integrated design software series, a general-purpose design tool that provides an innovative, cost-effective approach to systematically optimize the design of brittle material components using probabilistic reliability analysis techniques. Utilization of this software optimizes component design and manufacture on the basis of reliability and, consequently, achieves the best use of high-value-added ceramic and other brittle material systems in critical structural components subjected to tensile thermomechanical stresses.

This software combines multidisciplinary research—in fracture analysis, probabilistic modeling, model validation, and brittle structure design—with extensive computational capabilities into one comprehensive package to perform accurate computer simulation prior to costly component fabrication. Input for this software includes material data from simple experiments and stress and temperature distributions obtained from finite element analysis (FEA) of complex components. The CARES software is coupled to several commercially available FEA programs, to yield an integrated design tool that government, industry, and academia can adapt to their local computing environment.

CARES Probabilistic
Component Design Procedure

- Ceramics are brittle and have many flaws
- Random flaw size and orientation require probabilistic design methods
- Approach
  - Material failure characterization
  - Fractographic examination of ruptured specimens
  - Component finite element analysis
  - Component reliability
  - Design optimization



Simple test specimens

Complex component predictions

## Options for Commercialization

The NASA Glenn Research Center continually seeks cooperative partnerships with industry, government, and academia to develop new brittle-material life-prediction capabilities, further enhance existing technology, and provide valuable exchange of information on current structural ceramics research activities. The CARES series of software and the expertise of the developers are available to all interested organizations. You can obtain the CARES software from the NASA Glenn Research Center Software Repository (SR) at https://www.technology.grc.nasa.gov/software.

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## Key Words

Ceramic
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Life prediction
Design
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CARES
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